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FIRST LI-MONTHLY PROGRESS REPORT
UNIVERSITY OF ALASKA
ERTS PROJECT 110-1

September 30, 1972

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E. 72-1013.9

CR-128193

- A. TITLE OF INVESTIGATION: Coordination and Establishment of Centralized Facilities and Services for the University of Alaska ERTS Survey of the Alaskan Environment.
- B. PRINCIPAL INVESTIGATOR/GSFC ID: Albert E. Belon/U318
- C. PROBLEMS IMPEDING INVESTIGATION: Several problems, listed below, prevented the achievement of all the planned objectives for the reporting period but still allowed significant progress to be made:
1. ERTS contract was awarded by NASA on September 13, 1972, instead of sometime in July, as planned. A pre-contract authorization to expend \$5,000 as of June 7, 1972 was insufficient to carry the project to the date of contract award.
 2. No ERTS or aircraft data were received until the end of the reporting period.
 3. Major items of equipment (components for color-additive viewers and digital color display unit) require long delivery schedules and will not be received until the next reporting period.
- D. PROGRESS REPORT
1. Accomplishments during the reporting period.
 - a.) Coordination of aircraft program. The NASA Earth Observations Program mission 209 was conducted with the NASA NP3 aircraft from July 11 to 28, 1972 with the following results:
 - Project 110-2, 3, 4 and 14 (the 148th meridian transect of Alaska). All flight lines were completed as scheduled except for the predawn flights for line 6, 8, and 9. One of the KA-62 (multispectral) cameras malfunctioned on parts of lines 1 and 3.
 - Project 110-9, (Prince William Sound, Alaska). All flight lines were completed as scheduled except for line 31 which was not attempted owing to the laser profiler sensor being non-operational.
 - Project 110-2, (Fault line study, Fairbanks area). All flight lines were completed as scheduled. The SLAR flight lines were flown twice to provide data in both vertical and horizontal polarization.

- Project 110-13, (Wrangell Mountains, Alaska). All flight lines were completed as scheduled except for lines 39, 40, and 47 which had excessive cloud cover. No laser profiler data were obtained on any of the flight lines because the sensor was non-operational.
- Project 110-14, (Nulato and Point Hope, Alaska). All flight lines were completed as scheduled. On the whole, the aircraft mission is considered to have been very successful. Out of 2,591 miles of flight lines planned, 2,170 miles were completed as scheduled under very favorable weather conditions and 387 unscheduled miles of flight lines were completed at the request of the investigators. The prominent success of the mission is due to the aircraft crew, and in particular the mission manager, Mr. Gordon C. Hrabal, who exhibited a high degree of technical competence, efficiency, and a splendid spirit of cooperation with the University's investigators.

In addition to receiving a copy of aircraft data acquired for the University project, project 110-1 will also receive, for archival and reproductive purposes, a copy of aircraft data acquired by the NASA NP3A aircraft for the CRREL project SRT-025, (Cook Inlet) and for the USGS project 342-7 (Wolverine Glacier, Gulkana Glacier, Mt. Blackburn).

b.) Development of ERTS and aircraft data processing facilities.

- Project 110-1 has been assigned a large room on the ground floor of the Elvey Building (Geophysical Institute, Room 208). This room is presently being partitioned, remodelled, (at no cost to the project) and equipped to serve as an ERTS data processing laboratory with a completion date estimated to be October 15, 1972. It consists of:
 - The ERTS data library which will contain ERTS data received by project 110-1 as well as a copy of ERTS and aircraft data received by the other University of Alaska projects. Maps of Alaska at scales of 1/250,000 and 1/1,000,000 and remote sensing manuals and reports will also be stored in the library.
 - The ERTS data viewing room, which will contain light tables, a stereoscope, monocular and binocular magnifiers, a micro-film viewer, 35mm projector and a color-additive viewer for 70mm.

The color-additive viewer was designed during the reporting period and is being built by the instrument shop of the Geophysical Institute with a completion date estimated to be November 1, 1972. It consists of four identical 70 mm

Beseler projectors equipped with 20 inch focal length lenses, adjustable diaphragms and film holders. Registration of the four images will be accomplished by adjustments of a specially built film holder in each projector. The projected image is reflected by a mirror onto a high-quality rear-projection screen located above the array of projectors.

- The ERTS photographic processing darkroom which will contain conventional contact printers and enlargers for color as well as black and white photographic products. The darkroom will also contain two specialized instruments purchased for the ERTS program: A MacBeth densitometer delivered in July, has been calibrated and is used for spectral signature identification and as a quality control device for reproducing ERTS data; a Mark III LogEtronic color and black and white contact printer, installed in July, has also been calibrated and is used to print the most difficult ERTS and aircraft negatives. We have also designed but not implemented, a modification of the Mark III contact printer which will allow its use as a 2X and 4X enlarger.
- The ERTS digital processing laboratory which will contain a digital color display unit (CDU) scheduled for delivery in November 1972, as well as conventional digitizers and plotters.

Detailed specifications for the CDU were prepared by the University in May and June 1972. Bids for the engineering design and construction of the CDU were solicited from several industrial firms. Contract negotiations were completed on June 28, 1972 with Interpretation Systems, Inc. Owing to its unique features and capabilities at moderate cost, the CDU is described briefly under section E, "Significant Results."

During the last three months, details such as the tape format, test tapes and specifications of contractor provided software have been worked out with the contractor. The contractor has indicated that all engineering and design is completed, the software has been written and is ready for debugging, and all components have been received. A test tape with numerous patterns for geometric and spectral calibration of the CDU has been generated by the University and will be forwarded to the contractor next week for use in the checkout system. The CDU should be assembled and debugged during October. Mr. Robert Porter of the U of A, will participate in final check-out of the equipment at Lawrence, Kansas during the last week of October. The CDU should be delivered to the University about the end of November.

- c.) Development of image processing techniques. This phase of our activities has been impeded by the lack of ERTS and aircraft data until recently.

Using 9.5 inch MSS positive transparencies of the Alaskan forest fire scene (ID # 1003-21355) provided by NASA in September, we have experimented with various techniques for reconstituting color images. The conventional technique, involving successive copying of positive transparencies for each band through appropriate filters to produce a composite color negative, yields high quality prints and transparencies but requires considerable time and effort to determine correct exposure and balance for printing. Another recent technique, 3M's Color Key process, although it is not intended to produce color prints and transparencies, may prove to be a more versatile and economical means of reconstituting color images for the purpose of ERTS data interpretation. The technique involves superposition of single-color positive transparencies (produced by the color key process), to reconstitute a false color image. Thus, it is similar to the use of a color additive viewer, except that it does not require expensive viewing equipment, only a good quality light table. We have used the color-key technique with a good degree of success in reconstituting several false color (including color infrared) representations of the forest fire scene.

So far no ERTS digital tapes with real data have been received from NASA. One set of RBV, and one set of MSS simulated tapes have been received. Tests were made with three tapes on the University's IBM 360/40 computer to determine if they could be read without difficulty. No problems were encountered, but since the tapes did not contain real images, the only processing done was to print-out a small portion of each tape set.

2. Plans for next reporting period.

During the next reporting period the ERTS data processing laboratory will be completed and in operation. In particular, we estimate that the color-additive viewer should be installed and in operation by November 1; the digital color display unit should be delivered about November 30.

We will continue to develop photographic data processing techniques with emphasis being placed on standardization, calibration and reproducibility of output products. If real ERTS digital tapes arrive, the initial phases of the digital data

processing effort should be accomplished during the next reporting period.

- E. SIGNIFICANT RESULTS: (See separate page.)
- F. PUBLICATIONS: None
- G. RECOMMENDATIONS: Many of the 70mm black and white negative transparencies received from NASA/NDPF (after 9/28/72), are extremely over-dense. While these negative transparencies may meet the current NDPF specifications, they are effectively unusable; therefore we recommend that the specifications be changed.
- H. CHANGES IN STANDING ORDER FORMS:
 - Original Order date: 6/20/72
 - Revision dates: None
- I. ERTS IMAGE DESCRIPTOR FORM: One form for scene 1003-21355-M mailed to ERTS Users Services on 10/10/72.
- J. ERTS DATA REQUEST FORMS:
 - One data request. August 22, 1972
 - Two data requests, August 24, 1972

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PRINCIPAL INVESTIGATOR: Albert E. Belon/GSFC ID U318

TITLE OF INVESTIGATION: Coordination and Establishment of Centralized Facilities and Services for the University of Alaska ERTS Survey of the Alaskan Environment.

DISCIPLINE: Interpretation Techniques Development

SUPDISCIPLINE: Digital Information Extraction Techniques/Interactive Image Processing

SIGNIFICANT RESULTS: Specifications have been prepared, and a subcontract issued to Interpretation Systems, Inc. for the engineering design and construction of a novel digital color display unit which will be used for automatic processing of ERTS data.

The color display unit is a disk refresh memory with computer interfaced input and a color cathode ray tube output display. Resolution of the system is 512x512 cells with three four-bit data words stored for each resolution cell. The system features both analog and digital post disk data manipulation and a versatile color coding device suitable for displaying not only images, but also computer generated graphics such as diagrams, maps and overlays.

Input to the color display unit is from IBM compatible 9 track, 800 BPI tapes, as generated by an IBM 360 computer. ERTS digital tapes are read into the 360, where various analyses such as maximum likelihood classification are performed and the results are written on a magnetic tape which is the input to the color display unit.

The greatest versatility in the data manipulation area is provided by the minicomputer built into the color display unit, which is off-line from the main IBM 360 computer and thereby becomes user oriented to a powerful degree. The minicomputer is able to read any "line" from the refresh disk and place it in its 4K-16 bit memory. Any process within the realm of a digital computer of this size can then be performed on the data and the results can be rewritten back on the refresh disk for display. Thus, considerable flexibility is available for post-processing enhancement of images by the investigator.